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Problem-solving in a Multimedia Learning Environment: The MILE@HOME Project

Mai Neo[a*], Ken T.K. Neo[b], Heidi Yeen-Ju Tan[c], Joyce, Wai-Jing Kwok[d], & Chen-Haw Lai[e]

[a-e] *Faculty of Cretaive Multimedia, Multimedia University Cyberjaya 63100, Malaysia*

Abstract

Problem-solving has been shown to be an effective teaching strategy to enhance the student learning process and inculcate students with skills to adapt to real-life situations. This paper presents the MILE@HOME project, which involved a problem-solving approach based on Cunningham, Duffy and Knuth's (1993) 7 pedagogical goals to engage students in their learning. Students worked in groups to solve a multimedia design problem. Results show that student exhibited high motivation, teamwork and enhance understanding for the project. Overall, the study showed positive encouragement of the use of such an approach in technology-backed classrooms.

Keywords: Interactive multimedia, MILE, Problem-solving, project learning, Malaysia, Constructivism

1. Introduction: Problem-solving as an educational approach to engage students

The problem-solving method was developed in response to the weaknesses in the traditional directed instruction which is generally teacher-centred (Barrows, 1986; Boud & Feletti, 1999). Recent research has pointed out the gap between the skills that graduates have when they finish school, and the skills required for the workplace. Such research has shown that skills required in the workplace include creativity, critical-thinking, problem-solving and communication skills (Tan, 2007; Tan, Teo & Chye, 2009), many of which are lacking in today's graduates. New technology-oriented instructional strategies

* Corresponding author. Tel.: +6-012-6080466; fax: +6-03-83125554.
E-mail address: neo.mai@mmu.edu.my.

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of teaching and learning have come into being (Mortera-Gutiérrez, 2006; Herrington, Oliver, Reeves & Woo, 2004) that enhance the learning process from the monotony of conventional learning (Dawson, 2008). As such, problem-solving is being adapted into the classrooms in order to engage students in their learning process. Research in Malaysian education has shown that constructivist-based approaches can lead to increased problem-solving skills and enhanced learning (Hong, Lai & Holton, 2003; Tan, 2007), and enabled teachers to better transfer their knowledge to their students in the classrooms (Herrington, Reeves & Oliver, 2010). Constructivist learning underpins the problem-solving approach where the problems presented are ill-structured, and students are encouraged to develop multiple perspectives and solutions to the problems (Savery & Duffy, 1995; Tan, 2007; Tan, Teo & Chye, 2009; Neo, 2010). Cunningham, Duffy & Knuth (1993), suggested seven pedagogical goals that should be present in such an environment, which would allow the problem-solving approach to allow student to experience constructivist skills. These include:

1. Provide experience in the knowledge construction process
2. Provide experience in and appreciation for, multiple perspectives
3. Embed learning in realistic and relevant contexts
4. Encourage ownership and voice in the learning process
5. Embed learning in social experience
6. Encourage the use of multiple modes of representation
7. Encourage self-awareness in the knowledge construction process

This shift in emphasis in teaching and learning has moved students from being the passive recipients of knowledge and information, as in the traditional directed instruction mode, towards the acquisition of knowledge and skills through a process of solving a complex task in a way which develops higher level cognitive processes such as defining and understanding, analysing, investigating, and solving a problem and presenting the solution (Tan 2007, Herrington, Reeves & Oliver, 2010). This has the effect of inculcating higher level thinking skills into the students. Another important aspect of this learning approach is that it places great emphasis on the social context of the learning environment. In this learning mode, social interactions enable students to learn with and from one another and this can lead to increased development of cognitive and intellectual skills, knowledge and understanding (Vygotsky, 1978).

Problem-solving learning environments are characterised by experiential learning, which result in affective objectives fulfilled. These include improved attention and focus to the content, increased motivation and engagement to the learning process, and an overall enjoyment and satisfaction for the task at hand (Neo, 2010). Problem-solving is also effective when the learning environment emphasises social and collaborative work among the students. These would enable students to learn with and from one another and this can lead to increased development of cognitive and intellectual skills, knowledge and understanding. It is through problem-solving that learning takes place, and that "the medium of learning is a social negotiation of meaning, not content…so knowledge emerges in the discourse of the community" (Jonassen 2007). The learning becomes a socially negotiated activity where students, peers and teachers evolve to being a learning community to construct solutions to the problems collectively.

In addition to this, if the learning environment presented has elements of authentic and relevant tasks to solve, the levels of engagement in the students are more likely to increase (Herrington, et.al (2004). In other words, students learn best when placed in an environment where they can work collaboratively with their peers and interact socially among themselves to discuss and exchange concepts and ideas to solve a realistic problem. Therefore, the problem-solving learning environment in this study emphasised a multimedia design project, embedded in a learning environment that allowed students to collaborate and communicate in groups. Such an environment would be reflecting real-life situations in the workplace, where working in groups to solve problem would be authentic and relevant.

Currently, with the advent of Web 2.0 technologies, students' problem-solving experiences can be further enhanced as they are enabled with collaborative and communication tools to organise,

exchange, reflect, socialise and work together easily (Deitering & Huston, 2004; Kajder & Bull, 2004). As such, the MILE@HOME presents students with an online platform for students, with a two-fold objective: To allow students to learn from online interactive multimedia modules, and provide students with the ability to blog about their progress in their project and demonstrated their problem-solving processes.

2. The MILE@Home Project: Problem-solving with a multimedia design project

The problem-solving project was developed under the MILE@Home (Multimedia-mediated Interactive e-Learning Environment) project, a Telekom Malaysia Research & Development (TM R&D)-funded project with a grant of RM90,000. In the MILE@Home system, online modules where developed using authentic learning principles suggested by Herrington et al. (2004), which would allow students to engage in both their cognitive and affective learning processes. In addition, students were also provided with a dedicated blog space in the MILE system for them to blog about their project progress. This study was carried out with the cooperation of students from Multimedia University who were enrolled in an undergraduate class for 14 study weeks. The class had 36 students (n=53) and comprised of both local Malaysian students as well as international students and had an even distribution of male and female students. At the centre of this problem-solving learning environment is the multimedia design project which incorporates Cunningham, Duffy & Knuth's (1993) 7 pedagogical goals. These goals are adapted to the student's project development process as shown in Figure 1.

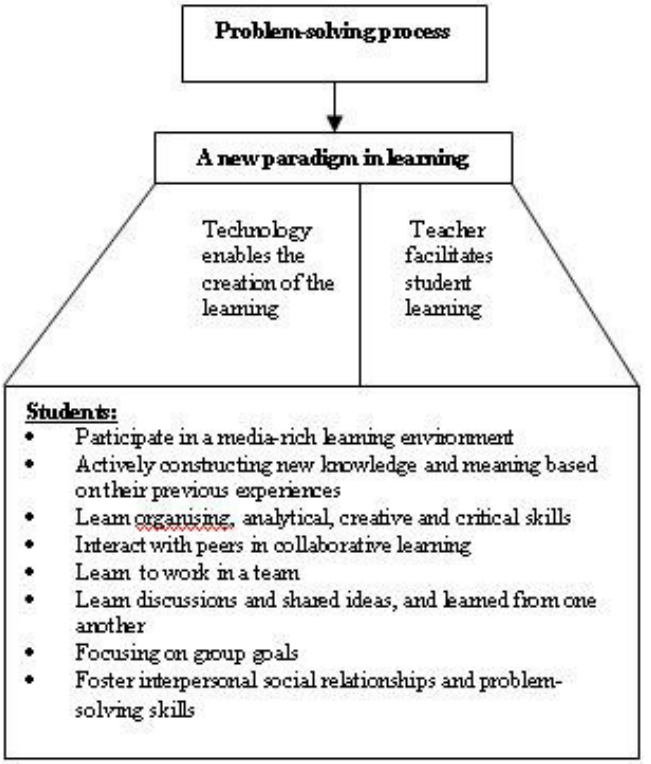

Figure 1 Problem-solving in a technology-backed student learning process

Students were given an authentic, ill-structured design problem in the form of a theme-based design project, "*Malaysian Culture*", to develop for the Malaysian Tourism Board. They were encouraged to decide on their own application's development approach and to form their own creative development teams with unique names. Lectures were provided for them via the MILE@Home learning system to give them content knowledge on the course syllabus. Figure 2 shows the MILE@Home's interactive modules to learn from.

Figure 2 The interactive modules in the MILE@HOME system

They were also required to set up blog accounts in the MILE@HOME learning management system to document their learning process. At the end of 14 weeks, students were to submit and present their final application on the project as well as their blog progress. Figure 3 shows an example of their blogs.

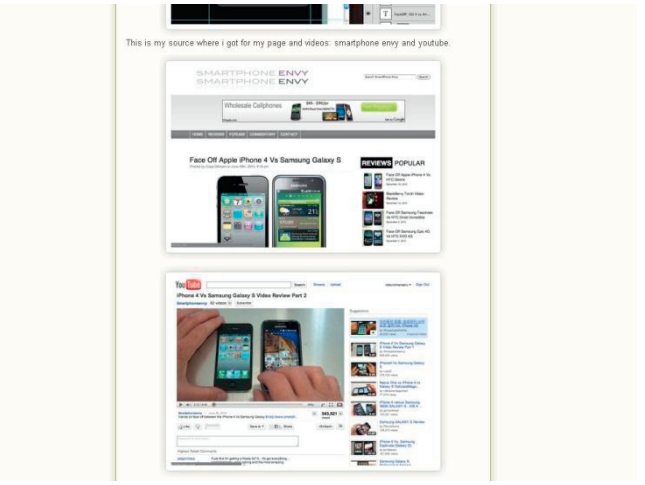

Figure 3 Blogging on their progress in the MILE@Home website

3. Analysis and Results

Students were given a survey questionnaire to assess their attitudes and perceptions towards the project and the learning environment. The survey was measured using a 5-point Likert Scale which begins with Strongly Disagree (1), Disagree (2), Undecided (3), Agree (4) and Strongly Agree (5). The sample size was 53 students (N=53). The data were analyzed using SPSS (Statistical Package for Social Sciences) version 11.0, and yielded a Cronbach Alpha coefficient of 0.821, which satisfied the requirement of survey reliability (Lim, Khine, Hew, Wong, Shanti & Lim, 2003.) The survey was conducted to gauge students on their perceptions towards the problem-solving experience of the project. Analysis on the survey items showed that the overall average means and percentages of responses towards these areas were favourable (i.e., students responding 'Agree' or 'Strongly Agree' in the scale). Table 1 shows the results of the survey.

Table 1 Survey results on problem-solving skills

No	Items (N=53) Cronbach Alpha = 0.821	Mean (m)	% (p)
1.	Able to apply skills learned	4.1	86.8
2.	Team solve problems in positive manner	4.0	83.0
3.	Able to be critical and reflective in thinking	4.0	81.1
4.	Willing to make improvements to keep project growing.	4.0	77.4
5.	Developed skills needed in real-world	3.9	79.2
6.	Team resolved problems together	3.9	79.2
7.	Increased team bonding via communication and collaboration	3.7	62.3
8.	Improved group management	3.6	62.3
9.	Improved presentation skills	3.6	56.6

From the results, students reported that working teams and blogs allowed them to solve their problems relating to their project. Students were very positive towards working in teams. 81.1% of students experienced critical-thinking skills (m=4.0) and an improvement in their presentation skills (m=3.6, p=56.6), and 77.4% of students reported a willingness to make improvements to keep project growing (m=4.0). Students also reported that the teams were able to resolve problems together (m=3.9, p=79.2) and positively (m=4.0, p=83). The survey also showed that a majority of them were able to manage their group effectively (m=3.6, p=62.3), and 62.3% reported that the smooth interactions in the group helped tighten the bond among their members (m=3.7). Students also reported that they were able to develop skills that were needed in real-world (m=3.9, p=79.2), as well as being able to apply their newly acquired skills in a more valuable manner on upcoming projects (m=4.1, p=86.8). These results were very encouraging as it showed that students were able to work together to solve their multimedia project design problem, and come away with contructisivist-based learning skills such as critical-thinking, teamwork, group management skills, presentation and communication skills, all of which would be relevant for them to use in their future work.

Students also reported that blogging their work allowed them to have "*diaries for our work.",* and created a learning environment whereby "*...everyone can see and comment is a good feeling…because it helps us to know our position".* Clearly, the development of the multimedia project, coupled with the ability to document their

progress through blogs resulted in the students feeling motivated and reporting that they improved their learning, as stated in their comments below:

1. "*We are not into spoon-feeding, that is pretty bad because you don't get to learn. If you solve your own problem it will benefit you, you feel more satisfied, feel more like a university student."*
2. *"Of course in a team, each member will do a part, everyone contribute something, and it will save us a lot of time. We can also discuss and meet up for the project. We can also learn from each other."*
3. *"Blogs were useful since it helped the group discuss the process [and] helped my team and I work together better".*

4. Discussion

From the results obtained, it can be seen that the study showed strong support for using a multimedia project in a constructivist-based learning environment to foster problem-solving skills among students. In particular, students demonstrated a deeper understanding of their project's topic and in multimedia development, increased problem-solving and creative skills, and higher motivation towards the project. It can be observed that the 7 pedagogical goals posited by Cunningham et. al (1993) were effectively mapped to the students' project developmental activities to create a successful multimedia-enhanced problem-solving learning environment.

Learning was active and students were very much engaged in their learning process, as they reported that they were able to see the relevance of the project to the skills that they would need for their future work, and supports Herrington et al."s (2004) suggestions for effective e-learning environments. The development of the problem-solving environment via project-based learning also supported the incorporation of authentic learning strategies as it provided students with real-world complex situations which they would have to solve collaboratively and cooperatively. By working together to complete the project, students developed realistic teamwork and management skills integral to their careers.

Team effort was also an important element in the group's success as they had to work together to achieve their goals. They were encouraged to harness their own abilities to use media effectively when representing various pieces of information to convey a message to the audience and to work collaboratively and cooperatively together. In doing so, they would be constructing their own knowledge of their projects and taking an active part in their own learning process.

Web 2.0 technologies and social networking tools provided students the opportunity to communicate with each other and solicit constructive feedback. By uploading their progress onto the web and commenting their peers' work, students developed more reflection on their own work and thus paid more attention to the quality of their project, again supporting the reflection strategy by Herrington, Reeves & Oliver (2010).

5. Conclusion

In conclusion, the study was successful in demonstrating the importance of incorporating problem-solving approaches in order to enable students to acquire critical-thinking, creativity, teamwork and presentation skills, and create a learning environment where they are engaged in the content and process. Here the results provide very positive and encouraging results for using multimedia design

projects in the classroom, and would be an effective learning framework for educators in Malaysia who are interested in enhancing their students' learning processes in a technology-backed environment.

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